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## Progress with Digital Modes and Techniques in New Zealand

A Paper from the New Zealand Association of Radio Transmitters Incorporated (NZART)  
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### Introduction

This paper reports on a range of developments and experiments with new digital modes and techniques in New Zealand over the last three years. Digital developments offer new frontiers in amateur radio, and provide a real technical challenge. The development of hardware, software and applications continues to involve the use of computers and micro-controller devices in amateur radio. This combination of technology provides an attractive way of recruiting new people, or retaining technically capable amateurs with interesting new projects.

Digital modes, especially on HF, have continued to increase in number and popularity since the last report (Document 00/XI/067, Darwin). Modes developed or designed in Region 3 continue to have an impact on the world of Digital Modes. Despite the emphasis on narrow band error correcting high performance modes, there is increasing difficulty in operating in the narrow band segments of the bands, especially due to increased activity of aggressive bulletin board services.

The use of the Internet in the radio shack has proved to be more of a benefit than a threat to radio communications. Email, email forums and program file download facilities are especially valuable for digital mode enthusiasts. Internet radio voice linking systems such as IRLP are now also becoming popular.

Micro controllers find uses in many fields, but are increasingly being used by Amateurs for beacons, digital mode transmission and general control, test and display purposes. (Companion papers give more details on micro controllers and precision frequency beacons).

### Popular Digital Modes

- **PSK31** - Throughout Region 3, and the rest of the world, PSK31 has maintained high popularity. Developed by Peter Martinez G3PLX, this mode

operates in a very narrow 50 Hz bandwidth using phase shift keying. The typing speed is good and the high sensitivity allows DX operation at quite low power. There are now many sound card programs available for PSK31. The platforms available range from Windows 3.1 through to the latest versions, and also LINUX.

PSK31 has proved quite successful in New Zealand for 6 Metre DX, with Duncan McMahon ZL3JT working VK2EDB and JR9DGU in late 2000, followed by a trans-Pacific contact with N6XQ early in 2001.

- **MFSK16** - A new digital mode designed in New Zealand by Murray Greenman ZL1BPU and programmed for the PC sound card first by Nino Porcino IZ8BLY, MFSK16 has taken the digital world by storm. This mode uses a similar bandwidth to RTTY, and has similar sensitivity to PSK31. It offers a major advance in reception performance through the use of Multiple Frequency Shift Keying (MFSK) modulation, Fast Fourier Transform (FFT) integrate and dump detection, and full-time convolutional code error correction. This is the first Amateur-designed mode to employ all these techniques. It uses 16 tones, and while sending at 15.625 baud achieves a 40 WPM typing speed. MFSK16 excels in long-path and trans-polar DX, which have been difficult to master with any digital mode. It also provides excellent Near-Vertical Incidence Sky wave (NVIS) performance. This makes it excellent for low power and emergency communications over shorter distances on the lower frequency bands. MFSK16 is now available in several software packages for Windows and LINUX. A recent development from the Ukraine has added an excellent narrow-band SSTV-like image transfer capability that operates seamlessly within the MFSK16 mode.
- **MT63** – This multi-tone (MT) mode has a small but dedicated following, as it provides reliable long path communication from the South Pacific to Europe on a daily basis. MT63 is an unconventional wideband digital mode, achieving robust communications through the use of a high level of redundancy and a Walsh-Hadamard error correction scheme. Using 64 carriers (tones) with 10 baud PSK, the data is spread in frequency and interleaved in time to achieve strong resistance to interference. The latest software gives excellent tolerance to tuning error, making unattended HF net operation practical.

### New Digital Modes in Use

- **MSTV and Digital SSTV** - Digital Mode developers in Region 3 are hard to find, but mention needs to be made of Con Wassilieff ZL2AFP, who has explored numerous techniques for transmission of text, data and images. Con's specialty is low resolution Medium Scan TV. He has very effective sound card software for this mode, using similar modulation to SSTV. Con is presently developing techniques for accurate but simple digital image transfer on 80m, where good image transmission is so difficult. One of his most successful systems uses two concurrent MFSK threads and a sync carrier, operating at 31.25 baud. At 256 bits/sec, this is one of the fastest experimental modes designed for NVIS conditions.
- **Digital Modes on LF** - Several countries within Region 3 enjoy operating privileges on LF. New Zealand Amateurs have been most successful with DX operations, being received around the Pacific. The ZL6QH team has made several one-way 180 kHz transmissions as far as VE7SL in Western Canada and

to the USA. The most popular mode is very slow FSK Morse (typically two minutes per dot), with dots and dashes of the same length, but on frequencies about 1 Hz apart. Extreme frequency accuracy and stability are required. The success of these transmissions can in part be attributed to the excellent weak-signal PC sound card software developed by Alberto de Bene I2PHD.

- **JASON** - An incrementally coded MFSK mode (IFK), JASON has also found favour for LF beacon transmissions. This unusual digital mode uses a bandwidth of only 4 Hz, and sends about 2.5 characters per minute. Based on an idea by Steve Olney VK2ZTO, JASON software was developed by Alberto de Bene I2PHD. It has the advantage of considerable drift tolerance, despite the narrow bandwidth. The first hardware implementation of a JASON transmitter was in an LF Exciter using direct digital synthesis, by Murray Greenman ZL1BPU. The signal from one of these 1 watt transmitters, built by David Brown ZL3FJ, has been received on 181 kHz by ZL1BPU at a range of 760 km.

The LF Exciter mentioned provides high accuracy and stability, both important requirements on LF. It will transmit on any frequency up to 400 kHz in sub-Hz steps, has a built-in multi-mode beacon, and supports many special LF digital modes. As well as the various Morse variants and JASON, it includes ASK Hellschreiber and sequential MFSK Hellschreiber, as well as offering a sweep generator mode.

- **VHF Success** – Rex Moncur VK7MO has pioneered the use of new digital modes for meteor scatter propagation. He has used modes such as fast Hellschreiber by Nino Porcino IZ8BLY and the specialized MFSK mode WSJT, developed by Joe Taylor K1JT. Following success contacting other VKs on 6m and 2m; in April 2002 Rex and Bob McQuarrie ZL3TY achieved the first trans-Tasman 2 metre meteor scatter contact.

### **Impacts on Digital Modes**

A number of impacts on digital modes are hindering developments. Interference and lack of operational skills are causing problems. The major impacts are:

- Severe interference from PACTOR and other bulletin board facilities is affecting the narrow-band Morse and digital mode sections of the bands, especially on 20 metres. In most cases the bulletin board station is not at fault, rather the calling stations tend not to take sufficient care to find the correct frequency and check that it is clear of other traffic before calling.
- The proliferation of PACTOR 3, which has a wider and more aggressive signal, is a further problem. Other unconnected stations, even when equipped with PACTOR 3 equipment, cannot monitor traffic in this mode. This means that it is effectively encrypted and therefore contrary to Amateur regulations in most countries. It is the opinion of many Amateurs that this commercial mode, and the bulletin board “service” provided, have no place in Amateur Radio. Monitoring traffic on bulletin boards (where possible) also shows that much of the traffic handled is clearly commercial in nature, again contrary to Amateur regulations. PACTOR 3 has been prohibited in many countries. Region 3 needs to consider whether to recommend that it be banned from the Amateur bands by member societies throughout Region 3.

## **A Look to the Future**

The future of Digital Modes is firmly with the use and developments of the PC and the sound card, and the associated software. As the performance of computers continues to improve, more sophisticated applications become possible.

Systems requiring considerable digital signal processing, complex compression algorithms used for images and voice, and the use of advanced error correction techniques all demand high (and increasing) processor performance.

Over the next few years we will see the emergence of high definition digital SSTV, currently under development by John Wilson VK3LM and his team; digital voice transmission, narrow band digital and analogue image modes, using text modes for liaison and synchronism, modes with secondary data channels, and voice to text and text to voice additions to the existing robust digital modes.

## **Recommendations**

### **That**

1. Region 3 Societies note the continuing activity and experimentation on digital modes and digital techniques in New Zealand, and in Region 3, recognising that they offer exciting possibilities on HF (and the higher bands) by merging the power of the PC with amateur radio
  2. Region 3 Societies encourage their members to experiment with new digital modes
  3. Region 3 Societies make their members aware of increasing PACTOR interference (especially on 20 metres) and request operators to take care to find the correct bulletin board frequency and check that it is clear of other traffic before calling
  4. Region 3 Conference considers recommending that PACTOR 3 be banned from the Amateur bands by member Societies throughout Region 3, noting that it has already been prohibited in many countries
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